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The application of Networked Music Performance to access ensemble activity for socially isolated musicians

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ABSTRACT

Networked Music Performance (NMP) allows musicians to play together over distances via the internet. For musicians who are socially isolated this is a valuable tool to allow musical connections despite barriers of geography or mobility. There are, however, challenges when using this technology, including how musicians cope with technical challenges (such as latency, and setting up and using NMP software), but also the challenges of communicating via potentially degraded audio and video links. By examining current research and a case study of the use of NMP at the University of the Highlands and Islands in a remote part of the UK, this paper argues that these challenges are not insurmountable. Meaningful musical relationships can be built and maintained using typical domestic equipment, and the network environment gives opportunities for musical creativity that would not be possible in a conventional rehearsal space.

1. INTRODUCTION

Playing music is an important part of cultural life throughout the world, and playing with other musicians is a vital social activity for many people, both professional and amateur. The health and social benefits of being part of a choir, for example, are clear [14], however there are barriers to participation in ensemble music for many musicians as a result of general social isolation. Factors contributing to social isolation may include long-term illness or disability, transport issues, low population density, or unemployment and economic struggles.

Networked Music Performance (NMP) allows musicians to play together across the internet, and can be achieved with minimal equipment and software. While some systems, such as LOLA [15] require specialist equipment and academic networks, domestic NMP software is also available, making it accessible for any musician with a broadband internet connection, computer, and webcam. This paper does not aim to discuss particular NMP technology solutions, rather it examines the factors affecting musicians using NMP in domestic situations and how NMP could benefit isolated musicians. An examination of these factors, and how musicians practically use NMP software, may be useful to developers of NMP software when making decisions regarding, for example, trade-offs between the bandwidth balance of video and audio, or the how latency is dealt with.

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2. SOCIAL ASPECTS OF NMP

NMP in the public eye has often been surrounded by publicity around the possibilities for technology to connect musicians – popular examples include a collaboration between Canadian band Barenaked Ladies and astronaut Chris Hadfield at the International Space Station [18], as well as numerous performances showcasing technology such as LOLA [15] at academic conferences. While useful to demonstrate the technical possibilities, these collaborations miss some of the major social benefits that are possible with NMP.

One obvious benefit is for musicians who are geographically dispersed, allowing them to work together across distances without needing to travel, and this is particularly valuable for musicians in remote and rural areas of the world who may feel isolated from others with similar interests. While performance is generally highlighted in showcased examples, all areas of ensemble music are possible using NMP, including education, improvisation, rehearsal, as well as performance. The purpose of the collaboration determines the requirements of the NMP connection, in terms of synchronisation and quality of audio and video feeds [1]. In many cases performance (which requires the highest connection quality) may be the least important of these for those wishing to make social connections through music.

Playing music as an ensemble includes social aspects: musicians often spend time together before, during, and after rehearsals and performances in non-musical social activities, building up personal relationships, and dealing with conflict. In a NMP situation, much of this time together has the potential to be lost as musicians can prepare and tune their instruments, for example, before they switch on the NMP connection, and then switch it off as soon as they have finished playing. This could allow fewer opportunities to get to know fellow musicians on a personal level, and good interpersonal relationships can benefit ensemble success [23].

Brown [4] highlights the importance of recognising that the interactions between musicians involve the negotiation of social and artistic relationships with others. In NMP musicians are not merely working with an incoming stream of audio (as they might be when recording overdubs in a studio, for example), but relationships with other musicians are as important as if they were working in the same space together. These relationships have the potential to be affected by the altered social contact in this setting. Examples of relationship-building in musical and online interactive environments are highlighted by Dillion and Brown [13] in their Network Jamming project, with children working remotely on music and visual projects.

In the context of computer games, Magerkurth et al. [24] argue that network-based interactions are socially 'inferior' to face-to-face interactions. Wright [34], however, argues that this is only true in a musical context if attempting to reproduce traditional face-to-face musical encounters. Most musicians using NMP are not aiming to do this; rather they are using the technology as a tool enabling unique interactions, which would not be possible in a traditional setting. Schroeder and Rebelo [31] highlight the differences between traditional performance spaces and networked performances, and their corresponding strengths. The network's strengths are the opposite of the concert hall's, allowing for experimentation and the musically unknown.

Rather than focusing on the barriers to creating music using NMP, Dessen [12] sees the positive aspects, where the feeling of distance and intimacy become parameters that can be used within composition, and that the use of interactive scores on screen, for example, can allow musicians to work beyond the limitations of conventional paper scores. In a NMP situation there is also potential for musicians to be affected by the 'online disinhibition effect', where they feel more relaxed and can express themselves more freely than in a collocated situation [32].

While there are clear technical difficulties facing musicians using NMP, some challenges facing musicians in this situation are related to social aspects of the collaborations caused by the use of technology. This is particularly the case with improvisation, where the interactive dialogue as well as style and quality of the music can be influenced by the technical set-up [25]. In NMP there is no physical space where musicians work, therefore the musicians do not encounter each other physically and can only confirm another's presence by interacting with them [16]. This is particularly true when there is no video connection, although even with a video link, an image on a screen of another musician is not enough to know they are available and ready to collaborate with. This introduces additional challenges to musicians, who may be used to playing relatively spontaneously when in a room together.

Easy access to online technology allows musicians to build up communities and NMP systems can be treated as community spaces to visit to connect with other musicians. Relationships between musicians can easily form in this situation, and rather than seeing NMP as an extension of traditional music making, NMP can be seen as a community-based model, where the collective skills of the community are a valuable asset [2]. These communities are particularly valuable to those who do not have easy access to other musicians, and transcend geographic and cultural borders.

When working with NMP, musicians may need to be aware of the social issues they are facing and ensure they are making the best use of the technology available to them. This might include making time before, during, and after working on musical aspects of their work to get to know their fellow musicians on a personal level, and using other technology such as email and messaging services to build up distance relationships. Equally, the strengths of the community aspects of NMP should not be overlooked, particularly where musicians are faced with challenges that make traditional forms of music making problematic.

3. NMP IN DOMESTIC SETTINGS

3.1 Technical Considerations

Given that the internet is not designed for the real-time transmission of audio, using NMP results in a different experience to playing in a room with other musicians. Audio and video connections can be used, which may or may not be synchronised, and these both suffer from latency. If more than two musicians wish to connect at one time then there may also be multiple latencies from different connections. Despite these challenges, musicians are very good at adapting to different acoustic environments, and therefore arguably the network environment. Several different approaches can be taken to these challenges, including the master/slave approach [8], which relies on musical leadership to maintain the flow of the music, or the acceptance of the network as having an acoustic itself and working with the artefacts it produces [9]. The effects of latency on synchronisation between musicians are well-documented, and the success of NMP for particular musicians, particularly in domestic settings, relies on this issue being accepted as a feature of NMP.

Some systems have aimed to get around the problems of latency through the use of distributed metronomes [2] or deliberately delayed signals that match with the beat of the music [10], however these prevent musicians from being free to choose their own musical content which may include tempo changes, or free rhythms. The simplest domestic systems may include an audio connection using software such as Soundjack [7] or JackTrip [5], and a separate video connection using typical video-conferencing software, such as Skype.

A further consideration for musicians using NMP is the technical expertise required to set up and use the software. Current dedicated NMP software, such as Soundjack [7] and JackTrip [5], require technical knowledge of networks to use, for example, and therefore are difficult to use for many musicians. There are opportunities for developers to use web interfaces to make NMP more accessible for musicians with limited technical knowledge. Considerations of latency, and the complexities around dealing with multiple latencies, for example, must be taken into account, which may require creative solutions. An example of a system that is accessible to those with minimal technical knowledge is NINJAM [10], which uses a web interface and deals with synchronisation by adding latency to match the pulse of multiple musicians. Further details on the addition of latency to enable synchronisation can be found relating to the Online Orchestra project [30].

Despite the challenges, NMP offers a huge advantage to musicians who are isolated in some way – they can access other musicians anywhere in the world (although geographically closer will result in less impact of latency) without needing to leave their home. Working as a duo is the most accessible form of NMP for musicians, both in terms of minimising multiple latency issues but also in terms of organisation and planning. Musical sessions online can be treated as jam sessions or rehearsals with musicians connecting via webcams for video, and either computer microphones or separate microphones and audio interfaces, depending on the equipment available and desired audio quality.

3.2 The Challenges of Domestic NMP for Musicians

3.2.1 The Musicians' Experience

While NMP may offer an accessible solution to the problem of isolation for musicians, the experience of working online is undoubtedly different to traditional ensemble playing: musicians may be working in their own homes; they will be using microphones and monitors, rather than hearing the other musician directly; and views of the co-performer may be limited by use of a webcam. In addition, any interactions are clearly defined by switching on and off the connection at the start and end of the session.

Successful ensembles have positive interpersonal relationships [27], and the social interaction between musicians is altered by the use of NMP, before, during, and after the musical content of a session. Existing relationships between musicians can help with the interaction, as performers trust, respect and support their fellow musicians while playing online [19], however for the truly isolated musician, co-performers may never meet in person. In these cases, effort must be made my both parties to build socio-emotional relationships by allowing time for informal discussion and conversation as part of a musical session, much as would happen in a typical rehearsal or jam session.

In addition, musical leadership can help musicians deal with latency problems. This requires communication and negotiation (which may be deliberate or subconscious) between musicians, and how well musicians adapt to the actions of others depends on their shared knowledge and rules [33], which develop over time. This suggests that over time, musicians will get to know one another's particular playing styles and negotiate methods for dealing with any technical difficulties. It is, therefore, important that NMP is not discounted as an option for isolated musicians if they initially face difficulties when using the technology.

3.2.2 Communication

Communication between musicians is a two-way process, with musicians' body movements and the music itself transmitting information, and other musicians receiving this information via their gaze and listening. When playing in a room together, this happens in ways that are conventional to the genre, and are well rehearsed. In NMP, however, the communication is mediated by an audio and video link. The impact of this interface is two-fold: it causes degradation in the transmission of the body movements and music (by limiting the area the receiving musician sees, as well as a reduction in video quality and addition of latency, for example), as well as the display of the image and reproduction of the sound (by using small video monitors and artefacts caused by compression, for example) [20].

This degradation will impact on the musicians' performances in several ways. Musicians may have difficulty producing coherent performances, as coordination of timing, dynamics and expression may be affected by the interruption to communication. Blending and tuning are particularly difficult when musicians are separated, for example [19].

An aim of any ensemble musician is to create a coherent performance with their co-performers, including coordination of timing, tuning and dynamics, requiring communication between musicians [21]. In a typical performance, the musicians can easily judge the success of this, because they hear roughly the same as what the audience hears (distance from instruments and therefore relative loudness notwithstanding). In NMP this is not the case: the idea of a coherent performance is nebulous, as each participant will have heard a slightly different overall performance.

It is therefore important to definite ensemble coherence for a NMP situation, and who judges this. Synchronisation of musicians cannot be considered a prerequisite in this situation, however coordination of musicians is still important. This may mean that the musicians do not play to exactly the same beat (one may be delayed), but a regular temporal delay between the parts may be considered coherent. Other musical factors may also be taken into account when defining ensemble coherence, including coordination of dynamic and tempo changes.

While a visual connection between musicians is considered by many to be vital for coherent performances, musicians tend not to use the video connection in NMP for the coordination of musical content [6,26]. Despite this, musicians do use video links when they are provided, but more often for discussions around the music, rather than when playing [20], a vital part of the rehearsal process [3,17]. This is particularly relevant in domestic situations, where high-quality video may not be available, and may not be synchronised with a separate audio feed.

3.2.3 Musical issues

The NMP environment may also affect the music produced, as communicative and technical difficulties impact on the musicians. The rhythmic content of the music will affect the success of an NMP session, with both steady, predictable, rhythmic music, and free improvised music being suitable for the networked environment. Steady, predictable rhythms allow musicians to use leadership – the 'master/slave' approach [8] – to maintain synchronisation, while freely improvised music can embrace the 'acoustic' of the network and work with latency and echoes, etc., to form part of the characteristics of the music produced, what is known as the 'internet performance style' [29].

Creativity and risk-taking, important parts of the ensemble rehearsal and performance processes, are reduced when musicians are physically separated [19], although this may improve as musicians become accustomed to working in NMP environments. Musical expression is also likely to be affected in NMP due to several factors that impact on expression. These include reduced visual contact [22], and therefore reduced perception of body movements [11], and lack of ensemble cohesion [21].

Despite these impacts on the music produced, many musicians working in domestic NMP environments are likely to be improving musicians, rather than professionals, where critical aspects of ensemble playing (such as details of ensemble coherence and expression) are still to be developed. Therefore the NMP environment may be better suited to these musicians than those whose ensemble skills are better developed. It is also possible that these skills could be developed over time that specifically meet the needs of the NMP environment.

4. A CASE STUDY IN THE SCOTTISH HIGHLANDS AND ISLANDS

4.1 Context

The University of the Highlands and Islands (UHI) is an institution in Scotland that provides traditional university education, distance learning, and blended learning (a combination of face-to-face, online, and video-conferenced learning) in the most northerly part of the country. The population density of the area is low, meaning that many students study at a distance while staying in their local area. The four-year, multi-genre undergraduate Applied Music degree was set up in 2012 to meet the needs of the many musicians in the area, who may want to study alongside a professional touring schedule, for example, or have other personal commitments that mean they do not wish to leave their local communities. As a result, there are now around 80 students based around Scotland and the rest of the UK, who are able to study wherever they are in the world, the majority of whom work from home. In addition, the lecturers who deliver the course are distributed around the Highlands and Islands.

To facilitate community-building and foster a sense of belonging, the students and staff meet face-to-face four times a year in locations around Scotland, and meet several times per week via video-conference. Students receive individual instrumental lessons,

which they may choose to do either face-to-face, or via video-conferencing, depending on their personal preference or situation.

4.2 Access to Ensemble Playing

Ensemble playing is a vital aspect of the students' music education [28], and students are expected to participate in (and facilitate) ensemble activity in their local area. For some students, particularly those in larger communities, this is straightforward, however for students who are more isolated, whether geographically (some students live on remote islands with limited ferry access, for example) or due to their genre (with few local musicians sharing similar musical tastes, for example) this can be more problematic.

NMP has been considered a solution to the problem of bringing student musicians together from the initial stages of designing the degree. Online collaboration is part of several of the modules in the first two years of the course, equipping students with the technical skills to allow themselves to share and collaborate on compositions and performances. File sharing has been the most commonly used method, with students building up recordings by recording themselves playing, and adding tracks to others' recordings. This has been particularly successful when there have been difficulties accessing internet connections that are fast enough for synchronous connections, however does not allow for spontaneous creativity that is possible with synchronous NMP. With internet access improving all the time, currently many students have access to superfast fibre-optic broadband, making synchronous NMP an achievable and attractive form of ensemble activity.

In their third and fourth years of study, students can choose to complete projects using NMP, as part of their research, and in these cases are encouraged to explore the possibilities of synchronous NMP, both within Scotland and beyond. Examples of student projects include collaboration between community groups of traditional fiddlers in the Scottish Borders and Shetland, as well as investigations into instrumental teaching via the internet. The scope of these projects are not limited to working with fellow students within the Highlands and Islands: it is particularly notable that when students have decided to use NMP in their projects they have approached musicians outside the student body in order to foster musical relationships within the wider community, despite the risks and technical difficulties involved.

4.3 Addressing the Challenges

While students are accustomed to using video-conferencing technology both in their education and personal lives, has not naturally developed to include music. NMP is technically possible for students, however currently there are several barriers that prevent it from being more integrated their day-to-day musical activities.

Firstly is the technical ability of students to set up the network connections needed for using specialist NMP software such as Soundjack [7]. This requires some knowledge of router settings and port forwarding, which may be problematic, particularly if students are involved in community projects that may require the organisation of many connections, and are working from home. In addition there are mental barriers, particularly in relation to the belief that latency makes NMP impossible in domestic settings, which as discussed, is not the case. Given the role that video plays in social interaction in NMP, and the limited role it has for musical coordination, students can be encouraged to prioritise the audio connection when playing (by switching off the video connection and allowing the bandwidth to be used for audio, therefore increasing audio quality), and re-establish video for discussion and other social interaction. Including NMP as an option on the curriculum has helped students to engage with the technology and therefore question their assumptions around latency, however some students are still reluctant to participate in NMP.

Students who are keen proponents of NMP often attempt ambitious projects, working with large groups in multiple locations. As previous discussed, this causes additional challenges of multiple latencies for musicians, and therefore smaller, one-to-one ensemble activity has more chance of success, which can then be built on as confidence and ability in NMP increases.

Possible solutions to these issues include further educating students on the challenges and opportunities of NMP, while placing them in the centre of finding solutions, and encouraging them to be innovative and creative in problem-solving. In particular there are many creative opportunities for using the 'acoustic' of the network (such as echoes and latency) in imaginative ways, rather than focusing on any limitations of NMP on the music played.

In addition, it is important that NMP in this context is used to enhance, rather than replace face-to-face collaborations. It is likely that NMP works better when there are pre-existing relationships between musicians, so for the best possible outcomes it is used in conjunction with traditional forms of ensemble music making, both locally and at residencies. This particular application of NMP may help overcome any negative impact on creativity, by allowing musicians to work both face-to-face and online on preparing for particular performances, or writing new music.

4.4 Future Plans

Although synchronous NMP as a tool for ensemble activity is currently in its infancy on the Applied Music course, it is likely that NMP will play a larger role in the future. Initially, this must start with further encouragement of students to become active participants in NMP and see it as a useful tool for ensemble work, rather than a novelty. Helping students to engage with the academic research in this area, as well as become participants in research projects (both their own, and their lecturers') may help them to see the opportunities that NMP provides them. In addition, a regular timetabled NMP ensemble activity (similar to a traditional music departments' ensemble activities, such as choirs and orchestras), with dedicated technical support for setting up connections, may encourage participation.

NMP also extends the possibilities of collaboration with other institutions, to enhance student cultural exchanges, with links made before, during and after any physical exchanges. This allows for longer-term relationships, whole-community partners, and with less need to travel, which has both economic and environmental benefits.

5. CONCLUSIONS

There is a perception that NMP is only successful with high-quality audio and video equipment, and extremely fast network conditions, to allow for real-time musical interactions that mimic those in a single physical space. This paper argues that this is not the case: meaningful musical relationships can be built and maintained using typical domestic equipment and internet connections (that are improving all the time). This means that NMP is a useful tool for musicians who are isolated physically (by geography, for example) or socially (through illness, for example). Minimal equipment is required, although some technical expertise is needed to set up connection initially, with the biggest barrier to use being the connection of the NMP software itself.

NMP may have an impact on the music played, in terms of what is suitable for the network environment, but this environment also

gives opportunities for musical creativity that would not be possible in a conventional rehearsal space. These opportunities are available for musicians playing any instrument, and at any level, and are potentially more suited to those who do not have highly developed ensemble skills in a traditional face-to-face setting. The online environment also has particular opportunities for community-building around the musical content, which would be beneficial for isolated musicians.

The Applied Music degree at the University of the Highlands and Islands has given an opportunity for students and staff to successfully explore the possibilities for the use of NMP for isolated musicians. Recent improvements in broadband infrastructure is now allowing synchronous NMP to be explored further, particularly in relation to preparation for ensemble work between face-to-face residencies, and to continue the community- and relationship-building that currently takes place. This model has the possibility to be extended into community music, and more informal ensemble practice.

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